(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
14 September 2017 (14.09.2017)

WIPO | PCT

(10) International Publication Number
WO 2017/152944 A1

(51) International Patent Classification:
H02K 5/15 (2006.01) *H02K 5/18* (2006.01)

(21) International Application Number:
PCT/EP2016/054843

(22) International Filing Date:
8 March 2016 (08.03.2016)

(25) Filing Language: English

(26) Publication Language: English

(71) Applicant: **ARCELIK ANONIM SIRKETI** [TR/TR]; E5 Ankara Asfalti Uzeri, Tuzla, 34950 Istanbul (TR).

(72) Inventors: **ACAR, Caglar**; E5 Ankara Asfalti Uzeri, Tuzla, 34950 Istanbul (TR). **OTUNC, Hasim**; E5 Ankara Asfalti Uzeri, Tuzla, 34950 Istanbul (TR). **TELEMEZ, Merve Ayca**; E5 Ankara Asfalti Uzeri, Tuzla, 34950 Istanbul (TR). **DURAK, Burcu**; E5 Ankara Asfalti Uzeri, Tuzla, 34950 Istanbul (TR). **GEDIK, Hakan**; E5 Ankara Asfalti Uzeri, Tuzla, 34950 Istanbul (TR). **SEZER, Rafi**; E5 Ankara Asfalti Uzeri, Tuzla, 34950 Istanbul (TR). **TIKIC, Goknur**; E5 Ankara Asfalti Uzeri, Tuzla, 34950 Istanbul (TR).

(81) Designated States *(unless otherwise indicated, for every kind of national protection available)*: AE, AG, AL, AM, AO, AT, AU, AZ, BA, BB, BG, BH, BN, BR, BW, BY, BZ, CA, CH, CL, CN, CO, CR, CU, CZ, DE, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IR, IS, JP, KE, KG, KN, KP, KR, KZ, LA, LC, LK, LR, LS, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PA, PE, PG, PH, PL, PT, QA, RO, RS, RU, RW, SA, SC, SD, SE, SG, SK, SL, SM, ST, SV, SY, TH, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.

(84) Designated States *(unless otherwise indicated, for every kind of regional protection available)*: ARIPO (BW, GH, GM, KE, LR, LS, MW, MZ, NA, RW, SD, SL, ST, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, RU, TJ, TM), European (AL, AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV, MC, MK, MT, NL, NO, PL, PT, RO, RS, SE, SI, SK, SM, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, KM, ML, MR, NE, SN, TD, TG).

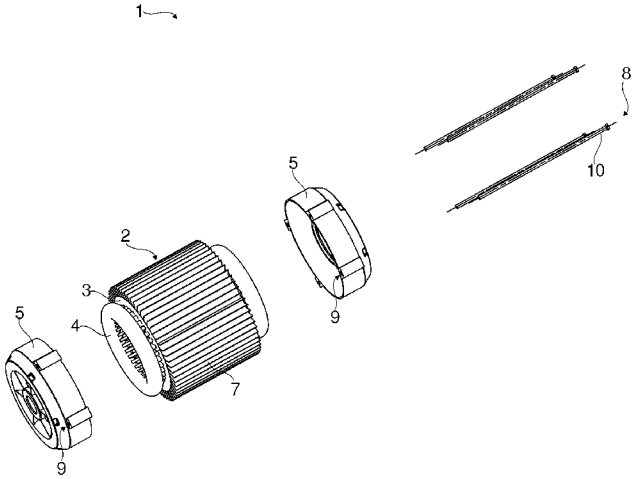
Published:

— *with international search report (Art. 21(3))*

WO 2017/152944 A1

(54) Title: ELECTRIC MOTOR WITH IMPROVED HEAT DISSIPATION AND ASSEMBLAGE

Fig. 7



(57) Abstract: The present invention relates to an electric motor (1) comprising: an outer stator (2) which includes a core (3) and a winding (4); a shaft; an inner rotor which is fixed to the shaft; and a pair of end shields (5). The electric motor (1) of the present invention comprises: an attachment means (6) which is adapted to attach the end shields (5) directly onto the opposite ends of the outer stator (2), wherein the outer stator (2) is exposed to the outside and provided without a casing that encloses its circumferential surface.

Description

ELECTRIC MOTOR WITH IMPROVED HEAT DISSIPATION AND ASSEMBLAGE

[0001] The present invention relates to an electrical electric motor for industrial applications.

[0002] Electric motors are commonly known in the art. Electric motors can be used both in industrial applications and in domestic applications. Figures 1 to 5 show an electric motor (1') which is known from the prior art. The electric motor (1') comprises: an outer stator (2') which includes a core (3') and a winding (4'); a shaft (not shown); an inner rotor (not shown) which is fixed to the shaft; a casing (5a') which encloses the circumferential surface of the outer stator (2'); a pair of end shields (not shown) which cover the front aperture and the rear aperture of the casing (5a') respectively; and an attachment means (6') which is adapted for the attachment of the end shields directly onto the opposite ends of the casing (5a'). The end shields and the casing (5a') protect the electric motor (1') from the intrusion moisture and dirt, and further dissipate the heat into the environment. During the operation of the electric motor (1') a large amount of heat is generated. Therefore, the electric motor (1') must be sufficiently cooled through the casing (5a'). The heat dissipation is of utmost importance in view of the thermal protection of the electric motor (1') and its performance. Figures 4 to 5 show a production process of the electric motor (1'). In this production process, the casing (5a') is separately formed through die casting or injection moulding. Next, the cylindrical casing (5') is press-fitted onto the outer stator (2'). In an alternative production process (not shown), the casing (5a') is fitted onto the outer stator (2') through heat-shrinking. In another alternative production process (not shown), the casing (5a') is directly formed onto the outer stator (2') through Aluminum injection molding.

[0003] US 2014/0117797A1 discloses an electric motor.

[0004] A common problem with the prior art electric motor (1') is that the aforementioned production processes are complicated and cost intensive. Moreover the production processes are vulnerable to faults which cause a reduction in the heat dissipation and an increase in the vibration of the

electric motor (1') during the operation. For instance, in the heat-shrinking process of the casing (5a') and in the press-fitting process of the casing (5a'), the outer stator (2') receives insignificant deformations, however, the contact established between the casing (5') and the outer stator (2') may be poor, and thus the heat dissipation may become insufficient and also vibrations may occur during the operation. In contrast thereto, in the Aluminum injection molding of the casing (5a'), the contact established between the casing (5a') and the outer stator (2') is improved, however, the outer stator (2') may receive significant deformations due to the high temperatures about 600 to 700 degrees Celsius, and thus the gap between the outer stator (2') and the inner rotor may not be accurately adjusted and the performance of the electric motor (1') may decrease.

[0005] The power of the electric motor (1') can be generally varied by using different outer stators (2') having different dimensions. Thus, another common problem with the prior art electric motor (1') is that the same casing (5a') cannot be used when the dimension of the outer stators (2') is varied.

[0006] An objective of the present invention is to provide an electric motor which solves the problems of the prior art in a cost effective way and which enables an improved production and assemblage and an improved cooling performance.

[0007] This objective has been achieved by the electric motor as defined in claim 1. Further achievements have been attained by the subject-matters respectively defined in the dependent claims.

[0008] In the electric motor of the present invention, the outer stator is exposed to the outside and provided without a casing that encloses its circumferential surface. In the electric motor of the present invention the attachment means is adapted for the attachment of the end shields directly onto the opposite ends of the outer stator.

[0009] A major advantageous effect of the present invention is that the need for the casing has been obviated by virtue of the outer stator which also protects the inner rotor and directly dissipates the heat into the environment. Thereby, the heat can be more effectively dissipated into the

environment and the performance of the electric motor can be increased. Thereby, also the production of the electric motor at different powers with outer stators having different dimensions has been comparatively improved both in terms of material and labor. Another major advantageous effect of the present invention is that the outer stator can be easily and securely assembled with the end shields. Thereby, the outer stator can be prevented from vibrating. Another major advantageous effect of the present invention is that the need for any of the heat-shrinking process of the casing, the press-fitting process of the casing, and the Aluminum injection molding of the casing has also been obviated. Thereby, the production costs can be further reduced both in terms of labor and material. In addition, the loosening problem of the casing has been eliminated. Another major advantageous effect of the present invention is that the need for reworking the gap between the outer stator and the inner rotor has been eliminated.

[0010] In an embodiment, one or more cooling fins are formed onto the outer stator. In this embodiment, the cooling fins may be integrally provided with the core. Alternatively, the cooling fins may be separately provided, and subsequently attached onto the core. These embodiments are particularly advantageous as the heat dissipation is improved through the cooling fins, and thus the performance of the electric motor can be further improved. These embodiments are also particularly advantageous as the number of the cooling fins as well as the size and shape of the cooling fins can be easily adjusted in accordance with the power of the electric motor or the actually intended operative power of the electric motor.

[0011] In other alternative embodiments, the attachment means has a releasable force-fitting connection and/or a releasable form-fitting connection, or a bonding connection. In another embodiment, the attachment means comprises a screw connection for screwing the end shields together and clamping the outer stator directly between the end shields. These embodiments are particularly advantageous as the end shields can be securely attached directly onto the opposite ends of the outer stator in various different ways which best suits the operating conditions and the

ambient conditions.

[0012] Additional features and additional advantageous effects of the electric motor of the present invention will become more apparent with the detailed description of the embodiments with reference to the accompanying drawings in which:

[0013] Figure 1 – is a schematic perspective view of an electric motor according to the prior art;

[0014] Figure 2 – is a schematic perspective view of the casing of the electric motor in Fig. 1;

[0015] Figure 3 – is a schematic perspective view of the outer stator of the electric motor in Fig. 1;

[0016] Figure 4 – is a schematic perspective view of the production process of the electric motor in Fig. 1, prior to press-fitting the casing onto the outer stator;

[0017] Figure 5 – is a schematic perspective view of the production process of the electric motor in Fig. 1, after the casing has been press-fitted onto the outer stator;

[0018] Figure 6 – is a schematic perspective view of an electric motor according to an embodiment of the present invention;

[0019] Figure 7 – is a schematic perspective exploded view of the electric motor of Fig. 6;

[0020] Figure 8 – is a schematic perspective view of the production process of the electric motor in Fig. 6, prior to screwing the end shields together and clamping the outer stator directly between the end shields;

[0021] Figure 9 – is a schematic perspective cutaway view of the electric motor in Fig. 6.

[0022] The reference signs appearing on the drawings relate to the following technical features.

1. Electric motor
2. Outer stator
3. Core
4. Winding
5. End shields

6. Attachment means
7. Cooling fin
8. Screw connection
9. Screw hole
10. Bolt

[0023] The electric motor (1) comprises: an outer stator (2) which includes a core (3) and a winding (4); a shaft (not shown); an inner rotor (not shown) which is fixed to the shaft; and a pair of end shields (5) (Fig. 7).

[0024] The electric motor (1) of the present invention further comprises: an attachment means (6) which is adapted for the attachment of the end shields (5) directly onto the opposite ends of the outer stator (2). The outer stator (2) is exposed to the outside and provided without a casing (5a') that encloses its circumferential surface (Fig. 6).

[0025] In an embodiment, the electric motor (1) further comprises one or more cooling fins (7) which are formed onto the outer stator (2) (Fig. 7).

[0026] In another embodiment, the attachment means (6) comprises a screw connection (8) for screwing the end shields (5) together and clamping the outer stator (2) directly between the end shields (5) (Fig. 7 and Fig.8).

[0027] In another embodiment, the screw connection (8) comprises: a plurality of screw holes (9) which are formed into the end shields (5); and a plurality of bolts (10) to be screwed across the core (3) into the opposing screw holes (9) (Fig. 7 and Fig.8).

[0028] A major advantageous effect of the present invention is that the need for the casing (5a') has been obviated by virtue of the outer stator (2) which also protects the inner rotor and directly dissipates the heat into the environment. Thereby, the heat can be more effectively dissipated into the environment and the performance of the electric motor (1) can be increased. Thereby, also the production of the electric motor (1) at different powers with outer stators (2) having different dimensions has been comparatively improved both in terms of material and labor. Another major advantageous effect of the present invention is that the outer stator (2) can be easily and securely assembled with the end shields (5). Thereby, the outer stator (2) can be prevented from vibrating. Another

major advantageous effect of the present invention is that the need for any of the heat-shrinking process of the casing (5a'), the press-fitting process of the casing (5a'), and the Aluminum injection molding of the casing (5a') has also been obviated. Thereby, the production costs can be further reduced both in terms of labor and material. In addition, the loosening problem of the casing (5a') has been eliminated. Another major advantageous effect of the present invention is that the need for reworking the gap between the outer stator (2) and the inner rotor has been eliminated. Other advantageous effects of the present invention can be taken from the above described embodiments.

Claims

1. An electric motor (1) comprising: an outer stator (2) which includes a core (3) and a winding (4); a shaft; an inner rotor which is fixed to the shaft; and a pair of end shields (5), **characterized in that** an attachment means (6) which is adapted for the attachment of the end shields (5) directly onto the opposite ends of the outer stator (2), wherein the outer stator (2) is exposed to the outside and provided without a casing that encloses its circumferential surface.
2. The electric motor (1) according to claim 1, **characterized in that** one or more cooling fins (7) which are formed onto the outer stator (2).
3. The electric motor (1) according to claim 1 or 2, **characterized in that** the attachment means (6) comprises a screw connection (8) for screwing the end shields (5) together and clamping the outer stator (2) directly between the end shields (5).

Fig. 1

PRIOR ART

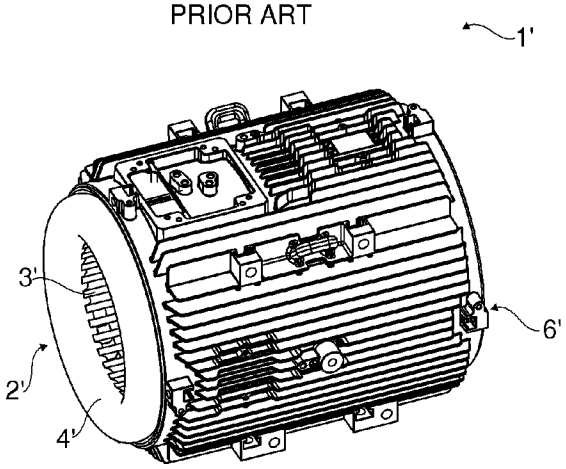


Fig. 2

PRIOR ART

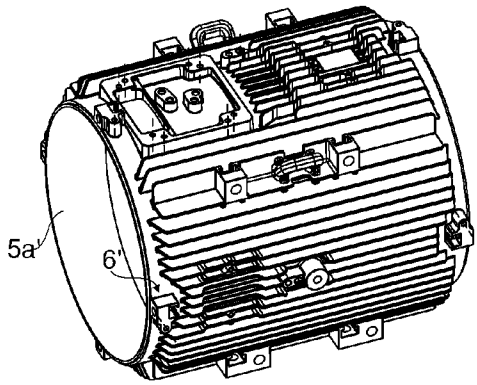


Fig. 3

PRIOR ART

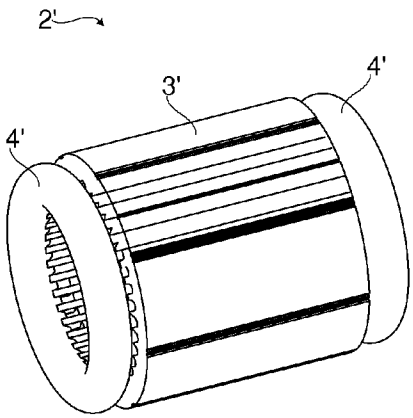


Fig. 4

PRIOR ART

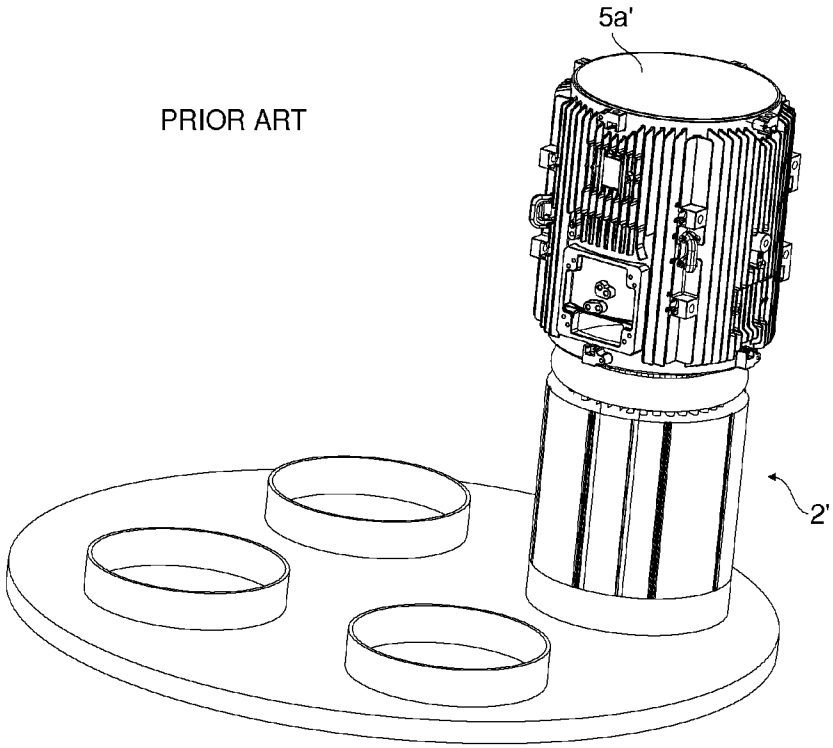


Fig. 5

PRIOR ART

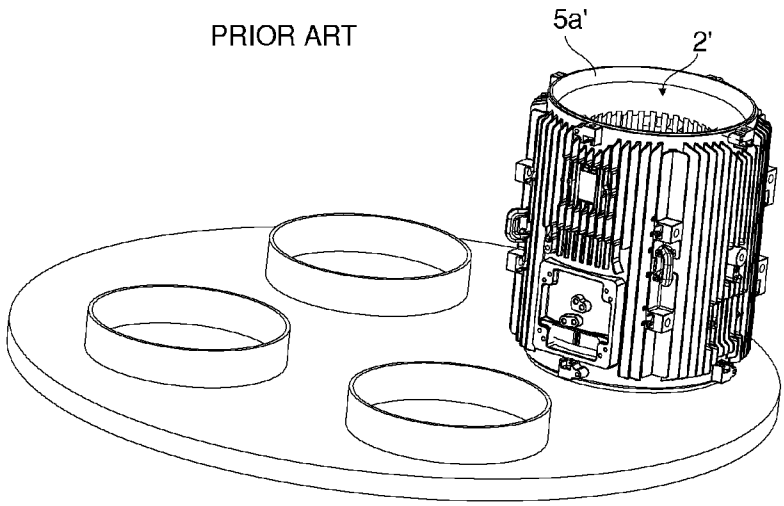


Fig. 6

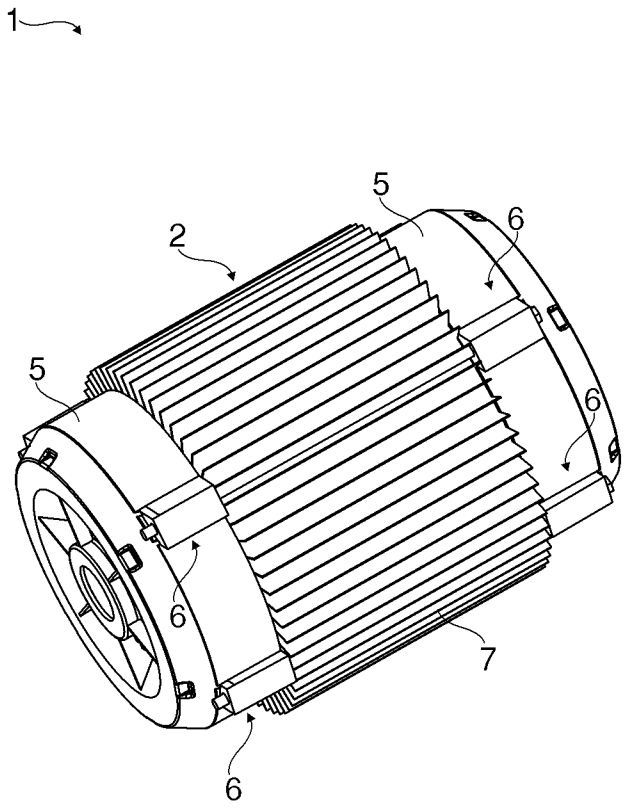


Fig. 7

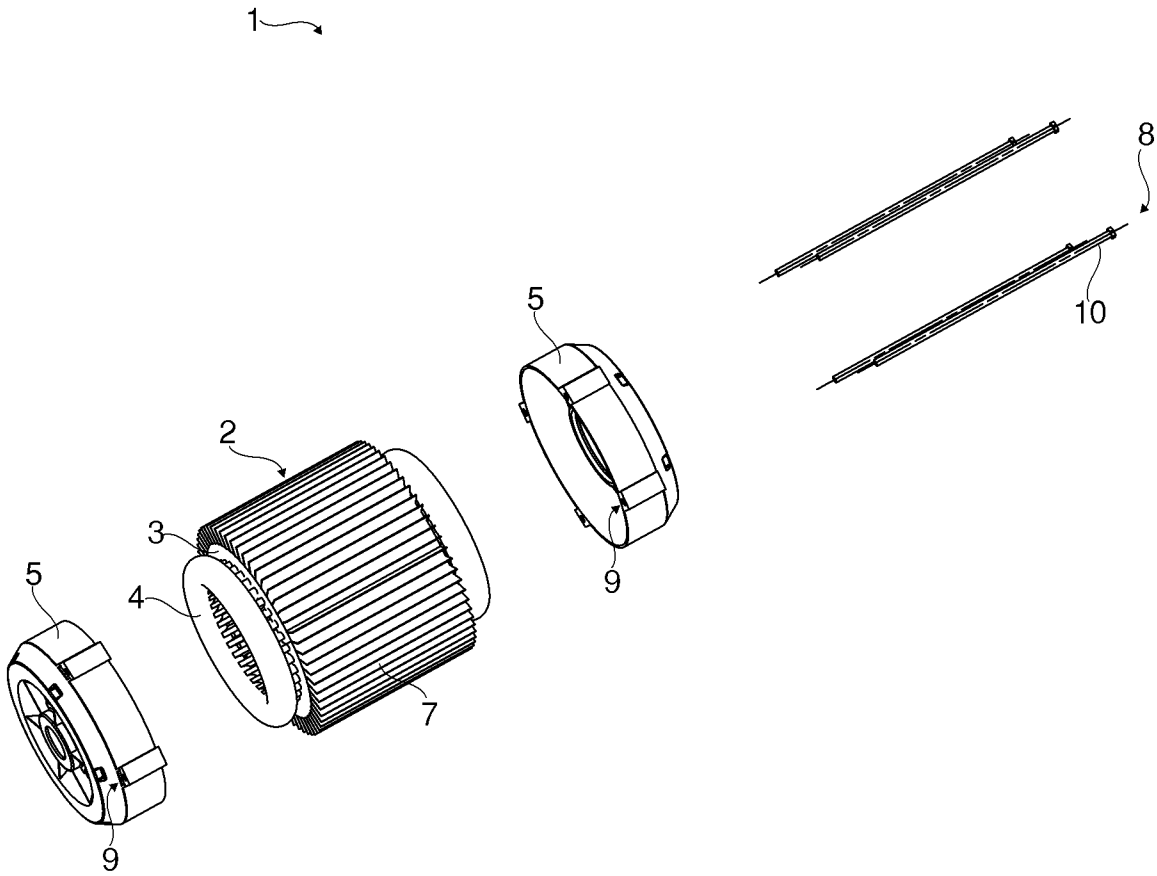


Fig. 8

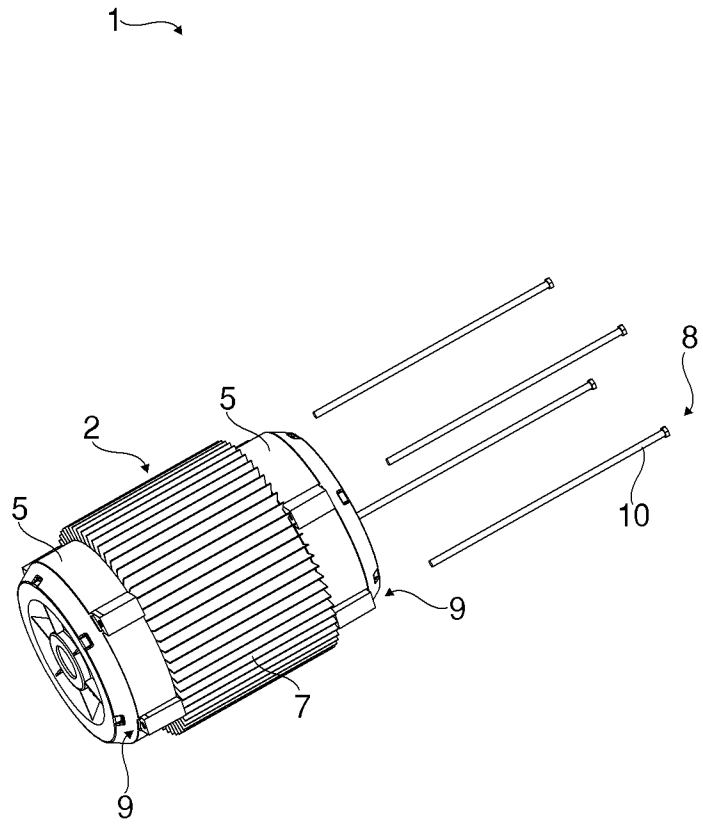
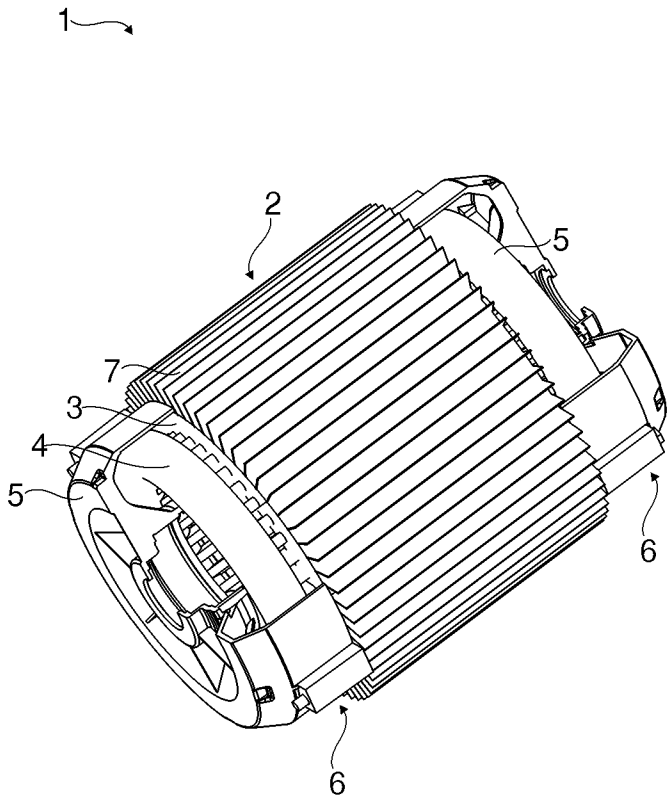


Fig. 9



INTERNATIONAL SEARCH REPORT

International application No
PCT/EP2016/054843

A. CLASSIFICATION OF SUBJECT MATTER
INV. H02K5/15 H02K5/18
ADD.

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
H02K

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
EPO-Internal, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	JP H09 46942 A (AISIN SEIKI) 14 February 1997 (1997-02-14) abstract; figures 5,6	1-3
X	DE 11 39 196 B (ELECTROLUX AB) 8 November 1962 (1962-11-08) paragraphs [0008], [0009]; figures 1,5	1,3
X	DE 10 2008 064131 A1 (MINEBEA CO LTD [JP]) 24 September 2009 (2009-09-24) paragraph [0045]; figures 1,2	1,2
X	EP 2 806 535 A1 (SIEMENS AG [DE]) 26 November 2014 (2014-11-26) figure 1	1,2
X	JP H03 49542 A (FUJI ELECTRIC CO LTD) 4 March 1991 (1991-03-04) figure 4	1-3

☐ Further documents are listed in the continuation of Box C.

☒ See patent family annex.

* Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier application or patent but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
9 May 2016	23/05/2016

Name and mailing address of the ISA/	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Fax: (+31-70) 340-3016	Kovacsovics, Martin

1

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No
PCT/EP2016/054843

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
JP H0946942 A	14-02-1997	NONE	
DE 1139196 B	08-11-1962	NONE	
DE 102008064131 A1	24-09-2009	DE 102008064131 A1	24-09-2009
		DE 102008064132 A1	24-09-2009
EP 2806535 A1	26-11-2014	CN 105308831 A	03-02-2016
		EP 2806535 A1	26-11-2014
		EP 2989711 A1	02-03-2016
		US 2016099617 A1	07-04-2016
		WO 2014187661 A1	27-11-2014
JP H0349542 A	04-03-1991	NONE	